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Household Waste Characteristics and Management: A Review

Dutta Mridusmita¹, Lekharu Kangkana², Phukon Himadree¹, Sonowal Sarojmoni¹, Kurmi Dipika¹ and Taid Tarun Chandra^{3*}

¹Department of Life sciences, Dibrugarh University, Dibrugarh, Assam, India

²Department of Zoology, Bodoland University, Kokrajhar, Assam, India

³Department of Zoology, North Lakhimpur College (Autonomous), North Lakhimpur, Assam, India

*Corresponding Author

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Abstract: Waste is a byproduct of minor economic value that is essentially worthless after primary usage. A waste product can be converted into an economic resource by increasing its value above zero. Human intervention has posed a threat to our natural resources by more waste production and low maintenance. To maintain our natural resources we must find new ways to reuse garbage, produce less waste and effectively manage inevitable waste. Studies and technology have also found role of waste in energy generation. In this review an attempt has been made to evaluate the major parameters of household solid and liquid waste management. The existing management practices, new innovations, challenges in waste management and future prospects in waste management are also reported. The study concluded innovative techniques of household waste management being the need of the hour.

Keywords: Waste, Disposal, Waste management, Household waste, Degradable, Non-degradable

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Introduction

Mother earth has provided us with a variety of resources. These riches are a blessing to humanity. They altered the prior circumstances, resulting in the birth of contemporary world. Human population growth has raised the demand for living space, but mother earth has provided us with all the necessities to live a carefree existence. Along with growth and development, has posed

the issue of waste. The Resource Conservation and Recovery Act of 1976 (RCRA) defines solid waste to include garbage, sludge from municipal sewage treatment plants, ash, mining waste, waste from construction and some hazardous waste (Ashalakshmi *et al.*, 2010). Now that we know that waste is something that is no longer useful, it must be discarded. But everything has its own way of

processing information. The word 'Waste management' is used here. For proper waste disposal, many waste management strategies are used. There are two types of household waste; Biodegradable and Non-biodegradable. Biodegradable waste is environmentally benign and thus can be decomposed by microorganisms because it does not harm the environment. Non-biodegradable garbage decomposed slowly or not at all and thus remains in the soil for a long time, generating pollution and putting pressure on our ecosystem hence, these types of waste must be segregated or recycled. Waste segregation can be defined as the process of separating out biodegradable and non-biodegradable waste into separate bins (Banga *et al.*, 2013). Waste can also be classified as dry or wet. Wet waste comprises all of our kitchen waste whereas dry waste contains all of our paper wastes, metals and so on. Liquid waste is another category of waste generated by households. Waste water generated from our bathroom, kitchen, laundry is termed as Greywater (UNICEF, 2012). Because waste categories change, so do waste management practices. Waste management is the term used relate to materials produced by human activity and the process is generally undertaken to reduce their effects on health and the environment (Adogu *et al.*, 2015). The prior focus is on the sources from which these waste are generated. These garbage disposal strategies have a direct impact on human health, vegetation and animals. Human infections can be caused by improper waste management. These infections can be caused by tainted food and water. Some of the disorders are also lethal. Improper waste management also has an impact on plant development. Plants suffer as a result of contamination induced by waste generation. However, studies on waste management have also shown that waste paper improves plant growth and performance which suggest using waste paper as soil conditioner (Jones *et al.*, 2020). Waste papers from households can be recycled and reused in this manner. Animals are also more

vulnerable to the household waste produced. Food waste from our households are used as animal feed, however, this is not always safe and can result in disease epidemic such as foot and mouth disease and African swine flu in pigs (Salemdeeb *et al.*, 2016). However, studies also suggest that treating food waste by heat renders it safe as animal feed (Garcia *et al.*, 2005). Each of the statements above suggests the need of proper waste management. The challenges in household waste management in India drive the motivation for the present study. This paper makes an attempt to focus on important parameters of waste and its management so that India can permanently achieve zero waste goals.

Both urban and rural homes produce a significant amount of waste. A study on household waste among residents of Malaysia showed that 74.3% of households disposed food debris as waste and 18.3% disposed plastic material as waste. The study also revealed that only 50% of households segregate their waste while the rest does not (Fadhulla *et al.*, 2022). Organic waste accounts up the majority of household waste. Nearly 70% of household garbage is organic waste. Fruit peels, vegetable peels and other kitchen debris, cattle dung, human excreta, pig excreta etc are examples of organic waste. Biomethanation process converts these wastes into Biogas which is used as a good source of fuel. Majority of organic garbage is composted. Compost is very stable and rich in nutrients than the raw materials and can be effectively used in crop productivity (Barral *et al.*, 2009). Composting is also found to be environment friendly technique of waste disposal. Vermicomposting is a well known term these days. Vermicompost has raised to prominence in household kitchen waste management practices. As a result, organic waste is best treated in this manner. Solid waste in developing countries like India are openly dumped due to low capital and high maintenance cost in advanced disposal methods (Moh *et al.*, 2014). There are various reasons for lack of success in the field of waste management. The lack

of public support is 1st in the list. In developing countries, waste picking is done by poor as an additional source of income keeping their health at risk of deadly diseases, aggravating the socio economic situation (Aweng *et al.*, 2014). The various diseases linked with improper management of household waste include cholera, malaria, dengue, respiratory problems etc. and studies have confirmed the same (George *et al.*, 2003; WHO, 2006). Apart from the disease transmission, the other problems associated with improper solid waste management are odour, nuisance, atmospheric, land and water pollution, fire hazards, aesthetical nuisance and economic losses (Yeny and Yulinah, 2012). Researches suggest various challenges faced by rural households in managing waste which are stated as – (i) Low awareness of segregation at source; (ii) Gaps in waste management assets; (iii) Non availability of low -cost technologies suitable for rural areas; (iv) Lack of involvement of community in planning/ decision making process which results in low accountability of the community; and (v) The low involvement of school students and youth in IEC activities (Manual-Biodegradable waste management).

Municipalities handle waste in metropolitan households. In urban areas, drain clogging is a major issue which causes floods during constant rains and act as a breeding ground for insects (Tchobanoglous *et al.*, 2002). Various areas under study suggest that nearly 30% households have access to dustbins (Omang *et al.*, 2021). In the present scenario most of the biodegradable household wastes are disposed using unsafe methods- untreated disposal in water bodies, burning, and unmanaged dumping. Household waste released into water bodies without significant treatment can pose a number of health risks to aquatic fauna (Malik *et al.*, 2020) and can also result in algal blooms because of high organic matter present in the wastes disposed. Studies reveal that the organic matter in solid waste in developing countries is much higher than that in developed countries (Bhide *et al.*, 1983). The amount of pure drinking water on the planet is

significantly less than the total amount of water on its surface. Soil contamination has received attention in this line as well too because solid waste disposal sites are seen to cause soil pollution in the allied areas. Solid waste dumps are found to change the chemical properties of soil reducing its strength and pollution of ground water sources due to percolation of toxic chemical (Pillai *et al.*, 2014). Chemicals are wreaking havoc on plants and agriculture. These hazardous chemicals also contaminate agricultural fields reducing harvest and harming the nation's economy. Technology has introduced biowaste as alternative sources of energy, fuel and fertilizer but it has its limitation too. Using biowaste –cow dung as fuel causes indoor pollution. Plastic, glass and other non biodegradable material waste is generated by both households. Population growth has resulted a rise in waste. World bank report shows that in the last two decades the amount of waste generated in China is very high due to increased number of population and economic growth (Tahir *et al.*, 2015). This situation has gotten worse due to the lack of awareness. Most cities dispose of rubbish in public places, making the environment unsanitary and filthy. As people's living standards have improved, so has garbage. Waste management generally includes various steps- (i) Proper collection of waste; (ii) Proper separation of various categories of waste; (iii) Proper transportation; and (iv) Recycling and proper disposal of waste materials.

It is the government's job to handle waste properly. Indian scenario has shown an increase in waste generation in urban areas to be 0.7 kg/person by 2025 (NIPFA). The government has undertaken various initiatives in the field of waste management and came up with schemes like Swatch Bharat Mission, Jal shakti abhiyan, Waste to energy, GOBAR-dhan etc. The Government has delegated authority under several parts to local government authorities. The assistance of the general population is required for good waste management. Proper management techniques can only result from proper knowledge. As a result, efforts should be made to educate the general

people about garbage and its correct treatment. Inadequate waste disposal expertise has resulted in the current global scenerio. The entire globe is fighting for survival since there is no place to breathe fresh air. There are rubbish heaps everywhere, municipal dustbins are overflowing with waste, dumping sites have random heaps, drains are clogged with garbage and much more. All of this has become a huge problem in today's world. There are numerous foundations comprised of young students. These foundations organise cleaning initiatives, waste disposal and management training and even plant trees in nearby locations to help clean the air. A case study in Imphal showed the active participation of various NGOs (TACDEF, SSF, CRED, WUM) in waste management process. NGOs can make a satisfactory contribution in the management of waste and joining hands with the municipalities (Singh and Dey, 2015).

Where we have discussed a lot about the cons part of waste we also need to throw light on the pros of waste. In the revolutionary era, the potential to recover power from household waste is diagnosed (Miyani *et al.*, 2020). Technologies have brought up various methods of generating energy from waste which includes thermal conversion, technological conversion and biochemical conversion. To meet the demand of energy through sustainable power generation, Thai government has encouraged electricity production from different renewable energy sources like landfill gases, biogas and organic wastewater. Energy from waste potentially reduces CO₂ emission (Peerapong *et al.*, 2016). Studies also show that energy can be generated from food waste. The nutrients and volatile fatty acids can subsequently be converted to electricity (Dahunsi, 2020). A case study in Nigeria showed probable electricity generation from municipal solid waste (Ibikunle *et al.*, 2019). Another case study on waste to energy generation has shown the generation of electricity from municipal solid waste by biochemical method. Biogas plant provides energy service to around 4 km to facilitate road light facilities. This initiative has

also led to reduction in total volume of municipal solid waste (Zore *et al.*, 2022). A mass burn waste to energy plant initiated which works on waste-to-energy principle and also works to control air pollution from wastes.

This study highlights the current status of household waste management practices of urban and rural areas and this review has been undertaken to comprehend the most effective household waste management practices changing the insight of the future generation in the field of waste management. Also finding alternative solutions have been discussed.

Categories of Waste:

Household waste is generally classified under biodegradable and non biodegradable waste. Few are stated in Table 1.

Advantages of Biodegradable Wastes Over Non-Biodegradable Wastes:

1. Biodegradable garbage decomposes i.e. it is not left in the environment for an extended period of time but non biodegradable garbage is left in our environment for an extended period of time.
2. Biodegradable substances can be utilised as fertilizers, for biogas generation, composting and so on but the only option to deal with non biodegradable waste is to recycle or reuse it, having in mind that not all non biodegradable waste is recyclable.
3. Natural decomposition is environmentally beneficial, quick and inexpensive but recycling non-biodegradable garbage is costly.
4. Biodegradable wastes aids in the reduction of carbon emission.

Hence, biodegradable wastes are preferred over non-biodegradable because it is environment friendly.

Another category into which household wastes can be classified is dry and wet waste which are mentioned in Table 2.

Table 1: Comparative study of biodegradable and non-biodegradable waste

S. No.	Biodegradable Waste	Non-Biodegradable Waste
1	Leftover food wastes	Fly ash
2	Bioplastics	Glass
3	Papers	Plastic
4	Ash	Metals
5	Dust and stones	Fertilizers, pesticides
6	Human waste	Electronic waste
7	Sewage sludge	Batteries
8	Manure	Medical wastes
9	Kitchen waste such as fruit and vegetable peels	

Source: Manual: Biodegradable Waste Management

Table 2: Comparative Study of Dry and Wet Waste

S. No.	Dry Waste	Wet Waste
1	Cartoons, empty bottles	Vegetable peels
2	Broken household metals	Used teabags
3	Aluminum foil	Leftover food
4	Plastic bags, gift wraps	Cow dung
5	Emptied tin cans	Broken glass
6	Empty papers	Egg shells
7	Bottle caps , metal boxes	Agricultural crop residues
8.	Used toothbrush	Fruit peels
9	Used door mats	Coconut shells
10	Used leather items	Used flowers, leaves
11	Glasswares	Rotten fruits and vegetables

Source: Manual: Biodegradable Waste Management

Dry waste is waste that is dry in nature whereas wet waste is waste that has a high moisture content and is little heavy due to wetness. Separate management of dry and wet home waste is required. The municipality also employs separate waste cans for dry and moist waste, as seen in many residential practices.

Impact of Waste Materials on Different Ecosystem:

These waste produced by various sources are toxic to the various ecosystems. Maintaining a healthy ecosystem state is an important way to achieve the sustainable development of the natural economy and society (Jin *et al.*, 2020). The

ecosystems are adversely affected due to contaminants in these wastes generated. Having a closer view at the adverse effects it comes to light that many of the constituents in these wastes are lethal too. We hereby discuss the relationship between waste and various ecosystems:

- *Aquatic Ecosystem:*

Household wastes which are released into aquatic bodies have proved lethal to many life forms. The World Health Organization (WHO) estimates that about 20% of world population has no safe drinking water and about 40% population lack adequate sanitation. The varied solid and liquid

household waste released into the aquatic bodies disturbs the BOD and COD of the aquatic ecosystem. These waste changes the physicochemical characteristics of the aquatic bodies, which presents long term unhealthy effects on the lifeforms. Reports have shown behavioural problems in aquatic organisms due to household and allied pollutants (Heckmann and Friberg, 2005). Species disappearance and migration are also reported due to heavy pollutants discharged on aquatic bodies (McIntyre *et al.*, 2005). The greatest volume of waste which is discharged in aquatic ecosystem is the sewage which contains waste from domestic wastes, waste from municipalities and a lot more. Eutrophication is the leading cause of destruction of aquatic lifeforms over the globe. Human activities accelerate the process of eutrophication.

- **Freshwater Ecosystem:**

Freshwater ecosystem is highly affected by urban waste management issues. From affecting the habitats of the freshwater flora and fauna to disturbing the normal functioning of freshwater ecosystem, the household pollutants have caused havoc to the ecological balance. Eutrophication and organic solvents from kitchen waste deplete the oxygen level of the water bodies. Pollutants affect directly and indirectly on the behaviour of aquatic organisms (Zala and Penn, 2004; Saaristo *et al.*, 2018). Mahmoud *et al.* (2008) reported that industrial, agricultural and sewage wastes caused renal injury of fish species dwelling in different regions of the Nile river. De-oxygenation decreases the levels of light penetrating the aquatic bodies which reduces the photosynthetic ability of Algae and macrophytes. The main problem arises with the downstream regions where the penetration of light becomes extremely low due to deposition of waste. Researches in this field conclude that to protect the global freshwater aquatic species and ensure normal functioning of ecosystems, it is crucial to identify the main pollution activities, their sources and their fate in the aquatic environment including their spatial distribution (Liu *et al.*, 2018; Zhao *et al.*, 2018).

- **Terrestrial Ecosystem:**

Soil is an important requirement for supporting life on earth but the improper management of waste affects the biophysical properties of soil which in turn poses threat to the supporting life forms. We live in a “plastic age” with more than 240 million tones of plastic used annually, the majority of which for disposal use. Globally around 260 million tones of plastic is used per annum (Thompson *et al.*, 2009). Micro plastics are seen to impose potential threat to the soil. Certain authors argue that soils might store more micro plastic litter than oceanic basins. Micro plastics affect the pore space and it also affects the particle interaction within the soil. Landfills used to dump household waste are found to release methane, a very powerful greenhouse gas linked to climate change. Methane is formed by microorganisms in landfills composed of food, paper and garden waste (European Environment Agency). Unprocessed waste is also a breeding ground for many diseases which affects the health of all living organisms. Contamination of soil proves fatal for many important plants too. The soil microbes which are highly important for many vital processes are at high risk from soil pollution. Ultimately this will lead to loss of biodiversity and many organisms have already declined due to heavy pollution created by improper disposal of waste.

- **Forest Ecosystem:**

Forest provide us with provisioning services like timber, bioenergy, traditional medicines etc., regulatory services like erosion regulation, regulation of water, air etc., maintains indigenous cultures, provide livelihood and a lot more. World bank 2.0 report in 2018 reported that the world generates 2.01 billion tones of municipal waste annually, with at least 33% of that are not managed in an environmentally safe manner (World Bank 2.0 report, 2018). Paper accounts for about 26% of total waste at landfills and our inconsiderate actions can lead to deforestation. UN environment researchers in Germany warned that the impact of micro plastic can affect the fitness of

earthworms in soil. This can further reduce the forest flora since they are dependent on earthworms. A decline in forest quality by the household waste generated can affect the services it provides. Affected forest can also impose serious threat to the forest fauna as they can suffer from various health hazards. Loss of flora and fauna will severely affect the human population which is depended on forest for their livelihood. The improper management of waste severely affects the soil which ultimately affects the forest flora and fauna. Some additives released by certain household waste can disrupt the hormone system of vertebrates and invertebrates. Forest fauna can suffer from suffocation, starvation, dehydration, intestinal blockage etc. due to plastic waste.

Existing Waste Management Strategies:

The annual quantity of solid waste generated in Indian cities has increased from six million tons in 1947 to 48 million tons in 1997 with an annual growth rate of 4.25%, and it is expected to increase to 300 million tons by 2047 (CPCB,1998). Studies have shown that the most of the solid waste from rural areas are biodegradable in nature. Conversely most of the waste from urban areas are non biodegradable in nature. A series of research work has been conducted on existing household waste management strategies in both rural and urban households and comprehensive review of which is given below:

Spandana *et al.* (2020) worked on “A Study on Solid Waste Management Practices by Rural Women in Medak ,Telangana State”. In this study four rural villages of Medak district was taken and the waste management practices followed by the rural women were assessed. The results revealed that most of them were aware of solid waste management (SWM).Appropriate measures were taken by the members of gram panchayat to collect household waste at regular intervals. Dustbins were provided to every household. Majority of the respondents managed dry and wet waste separately. Biodegradable wastes were used as vermicompost. Few of the respondents were found to use kitchen waste for pet animals. About

69% of the households were burning household waste (pads, polythene covers, leaves etc.) on their backyard. 80% of the households under study were found to follow the 3R's- Reduce, Reuse and Recycle. The results of the study revealed that there is significant relationship between SWM knowledge and SWM practices.

Viljoen *et al.* (2021) worked on “Household Waste Management Practices and Challenges in a Rural Remote Town in the Hantam Municipality in the Northern Cape, South Africa”. In this study the waste management practices of households in a municipality in the Northern Cape, South Africa were assessed. The result showed very few houses to use composting as a waste management and disposal practice. Only 1 house under study was found to reuse plastic product. A lesser number of households were found to donate electronics, old clothes, paper , food , glass etc. to a drop off centre. Few households burned paper waste and another few dumped paper waste. A little or no households were found to work on separating their wastes before disposal. The majority (80%) of the households placed all of their waste in a bag for collection by the municipality truck. The result of this study indicates that municipalities and households will have to collaboratively search for solutions towards effective waste management in rural areas.

Kumar *et al.* (2016) worked on “Solid Waste Management: A case study of Jaipur City”. The case study was done to study the prospects of Solid waste in Jaipur. The data acquired related to Solid Waste Management (SWM) was collected through visiting the sites and interacting with the peoples around. Households were found to be one of the leading producers of waste in the city. It was found that most of the population of Jaipur city disposes waste into the garbage bins, roads, drainage pipes, open areas etc. Most of the recyclable waste was also found to be disposed with domestic waste. Door to door waste collection services was assessed by only a few households. The report also explains that the primary collection of waste is the street sweeping.

The municipality collection system was not found to be active although 2-3 shifts of collection was seen daily. It was also seen that slum dwellers had no proper disposal system and garbages were found to be dumped near living areas. Plastic, leaves and other garbages were found to be burned anywhere without any management. In the municipality areas trucks, dumpers were seen to carry waste to dumping sites. The study concluded that there was no proper mechanism of waste treatment and many areas need to be reassessed.

Chavan *et al.* (2013) worked on “A case study on Municipal Solid Waste Management in Solapur City, Maharashtra, India”. The study was done on an urban city to investigate the present status of Municipality waste management in Solapur city. Data collection was done and the results were enlisted. The existing practices of household waste management were found to be door to door collection of waste by municipality workers. Many of the household throw their waste in community bins from where municipality collects and takes them to the dumping sites. The disposal was found to be done regularly in the area under study. The waste are dumped in landfills but the landfill sites were not well maintained. Some of the organic waste from the households is taken by the farmers for fertilizers. Most of the household wastes are found to lay open in the landfills. A treatment plant of anaerobic digestion was in progress to extract energy from organic waste generating the biogas. The study concluded that there were many areas which needed urgent consideration.

Nizar *et al.* (2021) worked on “Household Waste Management Strategy Towards Zero Waste City: A Case Study of Banda Aceh”. The study was conducted using interviews with waste management experts. Banda Aceh city’s waste management is handled by waste disposal service workers but the participation of households in proper waste management is found to be very low. The household wastes are not separated and recycling garbages are found to be extremely low. Food waste accounts for about 39% of total household waste. Landfills are the most seen

practice of waste management. In urban areas, the service workers move door to door to collect waste and deposit to the landfills. A new system was found in this study where a good number of residents delivered their household recyclable waste to the recycling centre located nearby. The organic household wastes are made into compost. It was found that methane gases produced as byproduct from the landfill waste were distributed as fuel to the nearby communities. Communities are an alternate source of waste management. High ranges of household organic waste are made into household compost. The government was found to have set up waste banks in the villages. 3Rs are also found to be followed by certain section of society. The villagers carry their waste to waste collection points set up by the government. Zero waste regulations have also been implemented in the areas to reduce landfill waste.

Babaei *et al.* (2015) worked on “Household recycling knowledge, attitudes and practices towards solid waste management”. The study was conducted among certain communities and their attitude towards household solid waste management was assessed. The solid waste were found to be wrapped in polythene bags and thrown at the backyard whereas in densely populated areas waste was thrown in storage containers near main roads. Lack of awareness on separation of different categories of waste was noticed in the area. Curbside collection was found to be the most practiced waste management method. All solid waste finally land up in landfills which are low maintained. The wastes are seen to be burned in open areas even the landfill waste are burned in open air. Training programmes were suggested to be implemented as to achieve proper waste management goal.

Mani and Singh (2015) worked on “Sustainable Municipal Solid Waste Management in India: A Policy Agenda”. The study included exposure to many research documents to share some success stories of municipal solid waste management. Research documents revealed that

100% door to door household waste collection has been achieved in 329 cities of Goa, Gujarat, Karnataka, Madhya Pradesh, Mizoram, Nagaland, Odisha, Sikkim, Tamil Nadu and Telangana. Self help groups were also found to be involved in Goa municipal council. Waste pickers are appointed to collect door to door household waste so that waste can be managed properly. An initiative 'ZERO WASTE' system was found to be adopted in Pune, Ahmedabad etc. Open dumping has been banned and the disposal of waste is done using scientific processing techniques. A mobile complaint redressal alert system has also been launched which is 1st model in waste collection and transportation to receive ISO certification. A lot more is yet to be achieved regarding waste management goals.

Prajapati and Patel (2018) worked on "Waste Management in Rural Area case study of Vadraj village, Dabhoi, Vadodara, Gujarat, India". The study was conducted in Vadraj village and the existing waste management in rural areas was assessed. The study revealed that the wastewater from households gets collected into a soak pit just like the one's used to build toilets in rural areas. Each house have their own soak pits where the wastewater from household gets filtered down to the groundwater table. Although this is an effective method for managing household waste water but it creates land pollution. The study also revealed that there is no transportation facility and also no proper public waste disposal area. Most of the biodegradable and non-biodegradable waste are thrown in open fields. Few households manage organic kitchen waste by feeding cattles, using as manure, composting, burying etc. The management of plastic household waste is not proper since they are thrown or burned in open fields. The authors have proposed vermicomposting, bio gas plant and rainwater harvesting as effective measures for waste management.

Shahi (2012) prepared a field report "Guheshwori Wastewater Treatment plant". The report highlighted an initiative taken by

government at Guheswori by building a wastewater treatment plant. This plant is also constructed to clean Bagmati river which suffers waste water discharge from household and allied sources. The plant treats untreated wastewater from households, industries etc. serving a population of around 198000. The population discharge their solid and liquid waste in rivers and there is lack of knowledge on proper management of household waste. The study concluded that there are lot more areas to be assessed .

Gonzalez *et al.* (2010) worked on Household Solid Waste Characteristics and Management in Rural Communities. The study was done using sampling methods in two rural communities in Mexico- San Quintin and Vicente Guerreo . The waste in the specified area was analyzed. The study revealed some household waste management practices followed which included collection of waste from households by service workers. Food waste constituted the highest percentage of household waste. Textile waste were found to be recycled. The 2nd hand clothes were sold at low cost indicating reusing waste materials. A good number of potential recyclable materials like aluminium, tin cans and other ferrous waste are collected and traded by local waste pickers. Many of the recyclable waste are commercialized. The study suggested implementation of waste collection centres, biodigester and compost to reduce the amount of solid waste. Various programmes were suggested which included recycling of waste, a sanitary landfill construction and proper waste collection system.

Joshi *et al.* (2016) reviewed on Status and challenges of municipal solid waste management in India. The study was conducted to evaluate major parameters of solid waste management and treatment options practiced in India. The existing municipal waste management practice is Segregation which is unorganized which makes the condition unsafe. Collection on a day to day basis is another means of waste disposal. Another method of waste disposal is recycling but the

study suggests that since waste are not segregated before disposal, maximum recycling is not possible. Municipal solid waste are collected by transportation vehicles to the public dumping sites. Landfilling is the most accepted waste management practice in India. The methane gas produced from landfill waste is used in energy production. The household organic waste are composted aerobically in presence of air. Vermicomposting is also an effective practice in managing organic kitchen waste from households. Anaerobic digestion (Biomethanation) has also emerged as an effective household organic waste management practice. The study has shown that certain places practice thermal treatment for household waste. Many gasifiers have been installed at various places in India. Refuse-derived fuel (RDF) plants are also been set up in places like Hyderabad, Guntur, Andhra Pradesh etc. Technology and equipments will help achieve the management target effectively.

Chaib *et al.* (2014) worked on “Household hazardous waste management in Malaysia”. The study was conducted by a questionnaire on handling of hazardous household waste. The respondents were enquired about hazardous household waste. Majority of the respondents agreed on following precautionary measures on handling hazardous waste. Regarding the storage of hazardous waste, it was found that majority of the respondents had separate storage areas. Some of the responded said they store hazardous waste in garage, some in bathroom, some in kitchen while remaining had no separate areas and are stored anywhere in the house mixed with the other household waste. Regarding the disposal of household hazardous waste some common practices were noticed. One included burning of the waste, other included collection by private contractor, other burying the waste in pits, poured into drain and arbitrary dumping. Some minor accidents were also reported while handling waste by the respondents which included skin irritation, damage, and poisoning. The study suggested initiative for awareness among the population on managing hazardous waste.

Abukasim *et al.* (2020) worked on “Alternative management of plastic waste”. In the study the author suggested measures to mitigate plastic waste including household plastic. Plastic waste has reached a critical stage as it enormously harms our ecosystem. There are effective ways to manage plastic waste(including household plastic waste) which includes the 3R's- Reduce, Reuse and Recycle. PET plastic can also be recycled into polyester fabrics and stuffing for feathers, carpets etc. Polypropylene plastic can be recycled too into brooms, brushes, rakes etc. The study also suggest an effective way to manage plastic waste i.e converting plastic waste into oil and fossil fuels (gasoline and diesel) by pyrolysis. The use of plastic in making oil and fuel can solve the problem of processing plastic waste and also fulfil the energy needs.

Current Trends in Waste Management:

The 50% recycling goal (nationally) has been set up by EPA by 2030 with nationwide recycling levels having stalled in the low 30% range for the past 20 years. National recycling is very appreciable and it has three main objectives to recycling strategy- (i) Reduction of contamination in recycling; (ii) Make recycling processing systems more efficient; and (iii) Strengthen economic markets for recycled materials.

If we consider food waste then it is markable that 40% of this food waste is created by business. Currently more than 20% of the trash in landfills is wasted food. Tied in with EPA's goal, 2022 was considered to be a year for organic infrastructure to expand particularly in areas that have already passed food waste recycling legislation. Regarding plastic waste we can consider 2022 as a significant year as coca-cola, pepsico like world's largest consumer product companies had set ambitious targets for replacing virgin resins with recycled ones with many aiming to achieve 25% recycled content by 2025.

Top 8 waste management trends and innovations in 2022 are- (i) Artificial intelligence, (ii) Robotics, (iii) Internet of things, (iv) Circular

economy, (v) Advanced recycling, (vi) Big data and analysis, (vii) Decomposition technologies, and (viii) Block chain.

In 2022, Canada's estimated total waste generation is the largest in the entire world. In India E- waste is growing at a rate of 10%. So now people need to be concerned about E-waste management in India.

In Europe, Netherland hold the leading position in recycling of household wastes with the rate of 51%. Though in the last 10-15 years, many new prospects viz. the introduction of producer responsibility for electronic equipment waste in 1999 and packaging in 2005 were done, they are looking for new development in waste management. They are recently trying waste pays and reverse collection approaches for household waste management (Goorhuis *et al.*, 2012).

Shen and Tam (2004) suggest that specific training and education programmes should be organized regarding proper waste management.

Challenges in Managing Household Waste:

Waste management needs awareness. Many researchers have worked on the topic and come up with the challenges faced by the rural and urban households on managing waste.

Beleya *et al.* (2019) worked on "Challenges in enhancing solid waste management towards sustainable environment: local council perspectives". The study was done by qualitative research in three different levels and it was found that there are many challenges in the field of waste management. Although landfill approach is a common waste disposal technique yet it causes undesirable effects to the environment and community. Municipal solid waste causes hazards to the community. Greenhouse gases are likely to increase at an alarming rate in the years to come. There is lack of technology and manpower in managing waste. Pretreatment of waste is not considered which makes landfill sites critical. Bad odor and toxic gases are released in the waste dumping areas. The factors need to be identified and accurate policies need to be implemented.

Joshi *et al.* (2016) reviewed on Status and challenges of municipal solid waste management in India. The study was conducted to evaluate major parameters of solid waste management and treatment options practiced in India. A common way of waste management is segregation of waste but it is not proper, therefore, scientific disposal is somewhere lacking. During collection of household waste, the same community bins are used for both household and commercial sectors. Another method of waste disposal is recycling but the study suggests that since waste are not segregated before disposal, maximum recycling is not possible. The transportation vehicles and maintenance are drastically low. The disposal of municipal solid waste is unscientific. The dumping sites are uncontrolled and open. Unscientific dumping is the primary reason of flood and surface water contamination. Appropriate funding is a primary challenge faced in lieu of waste management. A proper check on following ground rules is lacking. Landfills are running beyond their capacity. There is coordination issue among centre and state regarding the waste management goals. Although waste to energy projects have been implemented but success rate is very low. There is a need for appropriate technological solution to achieve the goal.

Future Prospects of Waste Management:

The scope of waste management is not limited to treating waste and recycling materials. If we truly want to devote ourselves in waste management, we need to reach out to the production sector and encourage creating products which are optimally recyclable. Waste pickers are of great importance in developing countries like India. In India approximately 1.5 million of subsistence informal waste pickers are known. If we can include them in formal waste management system, it will not only be an asset to urban areas but it can also be a good source of income for them. Waste management should always be proper, as poor waste management can contribute to hazardous condition. So, whenever we talk about managing waste it should be with a proper system and a

better vision.

Waste management includes all administrative, financial, legal, planning and engineering functions involving all solutions to all problems of wastes. The solution may involve relationships among fields such as city and regional planning, geography, economics, demography as well as political science.

If we see from another point of view, scope of waste management has now reached the highest level of individuals. Even if interested, one can make their career after degree or diploma. The post of Waste Management Officer needs a professional degree. Our education system offers many undergraduate and post graduate courses on waste management. Many students should actively involve themselves in waste collection programmes.

Conclusion

Waste and its handling require careful consideration. Waste can be a reward if it is dealt properly and kept under control. Waste may be reused and recycled and many industries and individuals are doing so. Waste materials are used in the art and craft sectors to create a variety of goods. Waste-to-energy is in the limelight. Municipal solid waste (MSW) can be used to generate electricity. MSW contains energy rich materials which can act as fuel to generate electricity. This has two benefits- reduction of waste and energy production. However, if left untreated or mishandled, waste can become our worst adversary-- The enemy that mankind can never defeat. Most of the world is already suffering as a result of poor waste management. The residential and industrial sectors generate the majority of waste. The need of the hour is to move forward. We along with the government can take appropriate steps to manage and dispose of these wastes.

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